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Memo

DATE: May 12, 2002

TO: RHIC E-Coolers

FROM: Ady Herscovitch

SUBJECT: **Minutes of the May 10, 2002 Meeting**

Present: Ilan Ben-Zvi, Michael Harrison, Ady Herscovitch, Jorg Kewisch, Thomas Roser, Triveni Srinivasan-Rao, Dejan Trbojevic, Dong Wang.

Topics discussed: Simulation & Calculations.

Simulation & Calculations: Jorg presented results of calculations he had performed at Jefferson Lab with Derbenev, and subsequently with Ilan upon his return. Initially, Jorg's calculations indicated that electron beam heating is severe. Those calculations indicated that a recirculating electron beam would be useful in cooling for no more than 30 turns. And as I stated (prematurely) in my May 3rd e-mail, "the recirculating ring approach does not look promising." However, as Jorg explained, useful cooling is strongly dependent on $\Delta\gamma/\gamma$, the fractional energy spread. In the parameter range of $\Delta\gamma/\gamma$ of 10^{-4} - 10^{-3} , the range of useful electron beam cooling is between 16 and 1600 turns. On the topic of magnetized beam transport, Jorg reported that the present design would not maintain electron beam magnetization.

For cooling calculations, analytical formulas were used. Basically, the set of equations solved represent energy conservation, in which the cooling time is assumed. The cooling time can be calculated from SIMCOOL and BETACOOOL. As long as the electron temperature is lower than the ion temperature cooling occurs. However, when the electron thermal velocity starts to exceed the ion thermal velocity, the cooling time starts to increase dramatically. Jorg examined, with MAD ray tracing, beam magnetization and realized that it is not maintained in the present system due to non-linear effects. The culprit is chromaticity generated by the quadrupoles. Stretching causes "twists" in the beam. Adding sextupoles did not solve the problem. Jorg found that the problem can be solved with 14 families of sextupoles, but there is no room to fit them physically.

A number of suggestions, to rectify the beam magnetization problem, were made during the ensuing discussion. But, there seems to be no easy "fix." Thomas pointed out that if resonances can be avoided, it would be easier to maintain beam magnetization with a recirculating electron beam. At the end of the meeting Ilan stated that we are at a cross road, and that substantial effort must be made to determine the best approach. Nevertheless, even a small number of circulations can be beneficial in reducing the current and lowering the cost.